

2nd. Edition

PATENT SPECIFICATION

590,235



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PROVISIONAL SPECIFICATION

Improvements relating to the Manufacture of Compound Glass and other Laminated Materials

We, SUNTEX SAFETY GLASS INDUSTRIES LIMITED, a British Company and ALFRED ROSENTHAL, Ph.D., of British Nationality, both of Leto Works, High Street, 5 Edgware, Middlesex, do hereby declare the nature of this invention to be as follows:

This invention relates to the manufacture of compound glass and other laminated materials by means of interleaving a plastic sheeting of the "Polyvinyl-Acetal-Type", e.g. between sheets of glass after wetting the plastic with a suitable organic liquid so to cause suction and adhering power to the glass when subjected to squeezing pressure, e.g. in a rolling press, without or with the simultaneous application of heat followed by an operation during which the rolled laminated glass is subjected to electric heat, gas heat, oil jacketed heat or steam jacketed heat and elevated or/and diminished air pressure that is, to heat under either elevated or diminished pressure or heat with successive stages of elevated and diminished pressure in a suitable autoclave (e.g. a cylindrical pressure vessel). This procedure has the advantage of yielding a laminated glass in which the interleaving material retains 30 more or less even thickness whereas by using platen or even fluid rubber-type presses in the laminating process the interleaving material is liable to squashing out at the edges thus producing "optical unevenness" in the laminated glass. One object of this invention is to produce laminated and splinterproof glass for optical purposes. Another object of this invention is to make the laminated glass or 40 other material unscaled. It has been found that polyvinylbutyral-sheeting known under the Registered Trade Marks "Butacit" and "Saflex" lends itself to the manufacture of a laminated glass with unscaled edges in conjunction with water-immiscible organic wetting liquid. In the Specification of Letters Patent No. 490,771 there have been described various plastic materials using water-immiscible organic liquids in the wetting and laminating process. This invention, however, is a further improvement with relation to

the processes described in Letters Patent No. 490,771 as the liquids used in the wetting process of the present invention have boiling points above 250° C. thus having lower flash-points generally than the liquids employed in Letters Patent No. 490,771. Also "Polyvinyl-Acetal-Type" sheeting such as polyvinylbutyral sheeting is superior as an interleaving material in the manufacture of laminated glass and of other laminated materials to the plastic materials mentioned in Letters Patent No. 490,771 from the point of view of combining light-stability, satisfactory water-resistance and toughness at ordinary temperatures with flexibility at low temperatures. This invention also differs from the previous invention with regard to the following points:

1) The liquids employed in this invention do not dissolve polyvinylbutyral in powder form within 5 minutes under vigorous stirring within the temperature range of 60°—80° F. as described for the plastic materials mentioned in Letters Patent No. 490,771.

2) The use of presses is excluded in this invention in order to produce a satisfactory laminated glass for optical purposes.

It has now been found that an organic wetting liquid which will scarcely soften the polyvinylbutyral-sheeting and at the same time cause satisfactory adhesion to the glass after processing in a pressure-vessel as described will preferably be taken from the groups of organic esters of phthalic and benzoic acid or their mixtures. A laminated glass of great toughness may thus be obtained by using e.g. 1) dihexyl phthalate or 2) a mixture of 75 ccs. of dihexylphthalate and of 25 ccs. of amyl benzoate. Other liquids employed in the laminating process which will yield softer and less tough laminated glass than that obtained by using dihexyl phthalate as wetting liquid are for instance dibutylglycol phthalate, diamyl phthalate, dibutyl phthalate, diisobutyl phthalate, and 100 amyl benzoate. Also butyl phthalylbutylglycolate and benzyl benzoate may be employed as organic wetting liquids for the polyvinylbutyral-sheeting.

AMENDMENT — SEE LAST PAGE

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However, as dihexyl phthalate is also a remarkably stable ester withstanding high temperatures without decomposition and low temperatures without crystallization it lends itself to the manufacture of laminated glass to be exposed to extreme climatic conditions.

Another purpose of this invention is to employ polyvinylbutyral sheeting which can easily be handled prior to laminating. It has been common practice to treat the surface of plasticised polyvinylbutyral-sheeting with soda to obviate stickiness on the surface during handling. This procedure, however, necessitates a washing procedure by using warm water and brushes with strong bristles to remove the soda involving a subsequent drying operation. Unless the mentioned operations are carried out with extreme care the resulting polyvinyl-butryal sheeting may show spots of dirt and dust after laminating. It has now been found that a polyvinylbutyral sheeting may be obtained with a non-sticky surface which may be as easily handled as a cellulose acetate-sheeting prior to laminating and which does not involve the aforesaid operations of putting soda on the surface of the butyral sheeting necessitating the subsequent operations as mentioned, if an unplasticised polyvinylbutyral-sheeting is employed which can be obtained by casting it from a solution with subsequent drying of the ensuing film according to the following formula for the casting solution:

150 gms. of polyvinylbutyral powder (Butvar 5598, Shawinigan)
 200 ccs. of ethyl lactate
 700 ccs. of Trichlorethylene
 300 ccs. of Industrial methylated spirits 64% o.p.

More trichlorethylene and spirits may be conveniently added to the casting solution to obtain more easily flowing solutions. The thus obtainable film of polyvinylbutyral-sheeting may be laminated using any one of the aforementioned organic liquids or their combinations with each other and by suitable choice of the liquid

e.g. either using dihexyl phthalate or amyl benzoate various degrees of toughness or plasticity may be obtained in the resulting laminated glass as required for particular conditions. It has also been found that polyvinylbutyral-sheeting may conveniently be dyed by drawing it through a dye-bath with subsequent drying of the dyed sheet according to the following formula given as an example:

20 ccs. of ethyl lactate
 20 ccs. of industrial methylated spirits 64% o.p.
 60 ccs. of ethylene dichloride
 5 gms. of fast orange A. 150 (I.C.I.) sold under the Registered Trade "Dispersol".

Organic dyestuffs may also be dissolved in the organic wetting liquid used in the laminating process to obtain various tones or tints of colour in the ensuing laminated glass. Coloured transparent polyvinylbutyral laminated glass as just described may be utilised in the manufacture of optical photographic filters. But it is also possible for the latter purpose to laminate coloured gelatin-filter-sheeting between glass by interposing it between 2 pieces of polyvinyl butyral - sheeting which may be laminated to glass as described thus yielding coloured gelatin. Polyvinylbutyral - sheeting laminated glass filters. In the manufacture of such coloured filters the glass may also be conveniently coated with a thin gold film prior to laminating for obtaining special optical effects of colour and light absorption. Also optical lenses, bent glass goggles and bent windscreen-sheeting may be made using polyvinylbutyral-sheeting as interleaving material. Also polymethylmethacrylate sheeting such as is known under the Registered Trade Mark "Perspex" may be laminated to glass by means of polyvinylbutyral-sheeting as described in this invention.

Dated the 20th day of March, 1945.
 HERON ROGERS & COMPANY.

COMPLETE SPECIFICATION

Improvements relating to the Manufacture of Compound Glass and other Laminated Materials

We, SUNTEX SAFETY GLASS INDUSTRIES LIMITED, a British Company and ALFRED ROSENTHAL, Ph.D., of British Nationality, both of Leto Works, High Street, Edgware, Middlesex, do hereby declare the nature of this invention and in what manner the same is to be performed, to

be particularly described and ascertained in and by the following statement:— This invention relates to the manufacture of compound glass and other laminated materials such as those including layers of porcelain, metal, wood, or synthetic organic products and to the kind of

compound material wherein a sheet or sheets of plastic material is or are interleaved between the sheets of glass or other material after wetting the plastic material with an organic liquid to cause suction and adhesion of the plastic material to the glass or the like under the action of pressure with or without the application of heat to form homogeneous laminated bodies or sheets.

The object of the invention is to provide an improved method of producing a laminated material of the kind above described whereby a product is produced free from inequalities both in form and appearance and which, when the invention is applied to laminated glass, produces a quality which is splinter-proof and particularly suitable for optical purposes and for other applications where the use of a compound glass is desirable.

The present invention is an improvement upon that forming the subject of prior Patent No. 490,771 and is designed to enable the compound glass or the like produced by the method according to the earlier Patent to be produced with greater certainty as to quality and rendered suitable for additional applications.

According to the invention the improved process for the manufacture of compound glass and other laminated materials employing for the interleaving material plastic sheeting of the polyvinyl-acetal type, is characterised by the application thereto of a substantially water-immiscible organic wetting liquid consisting of an organic ester of phthalic, or benzoic or phosphoric acid or a mixture thereof, in subjecting the assembled layers after treatment with the wetting liquid to mechanical pressure to eliminate surplus wetting liquid and in subjecting the compound material thus formed to final treatment under heat and under elevated or/and diminished pressure in a closed vessel, that is, heating with either elevated or diminished pressure or with successive stages of elevated and reduced pressure.

In carrying the invention into effect and in the preferred manner, the manufacture of compound glass, for example, is carried out by interleaving plastic sheeting material of the polyvinyl-acetal type such as polyvinyl butyral sheeting between the sheets of glass after wetting the plastic sheeting with a water immiscible organic wetting liquid of a kind which will scarcely soften the polyvinyl butyral sheeting and at the same time cause satisfactory adhesion to the glass after processing in a pressure vessel as hereinafter described. The organic wetting liquid is taken from the groups of organic esters of phthalic, ben-

zoic, or phosphoric acid or their mixtures and applied to the plastic material at approximately 85° F.

To obtain a laminated glass of great toughness the wetting liquid used may be dihexyl phthalate or a mixture of 75 ccs. of dihexyl phthalate and 25 ccs. of amyl benzoate. Other wetting liquids which can be employed in the laminating process and which will yield softer and less tough laminated glass than that obtained by the application of dihexyl phthalate as a wetting liquid are, for example: dibutyl glycol phthalate, diamyl phthalate, dibutyl phthalate, di-iso butyl phthalate, amyl benzoate, benzyl benzoate, butyl phthalyl-butyl-glycollate, tributyl phosphate, triphenyl phosphate and tricresyl phosphate. Of the above wetting liquids, triphenyl phosphate is solid at room temperature but can be used as a laminating bath when heated above 48° C. with or without the addition of a liquid plasticiser such as dihexyl phthalate. Also, triphenyl phosphate can be advantageously incorporated with the polyvinyl butyral sheeting for fire-proofing purposes. The dihexyl phthalate referred to throughout the specification is dihexyl phthalate (A. Boake Roberts & Co. Ltd.) which consists mainly of the phthalate of di-ethyl ethanol (2 ethyl butanol 1) the physical properties of which are as follows:

S.G.	1.019, 1.00830	
B.I.	1.492	100
B.P.	220° C. at 10 mm.	
	199° C. at 2.5 mm.	
B.R.	380°—400° C.	

Dihexyl phthalate is a very stable ester capable of withstanding high temperatures without decomposition and low temperatures without crystallisation. It is, therefore, most suitable for the manufacture of laminated glass which is to be exposed to extreme climatic conditions as the glass made with the polyvinyl butyral sheeting will not discolour or become brittle at extremely low temperature.

The present invention also provides for the interleaving material to be produced in a form capable of being easily handled prior to laminating. It has been common practice to treat the surface of plasticised polyvinyl butyral sheeting with soda to obviate all stickiness on its surface during handling. This procedure, however, necessitates a washing operation using warm water and brushes with strong bristles to remove the soda and a subsequent heat drying operation. Unless these washing operations are carried out with extreme care, the resulting polyvinyl butyral sheeting may show spots of dirt

and dust after laminating. It is, therefore, desirable to utilise a method of treatment which produces a non-sticky polyvinyl butyral sheeting in the first instance. 5 It has been found that the washing and drying operations can be eliminated and polyvinyl butyral sheeting produced which can be handled as easily as a cellulose acetate sheeting. According to the 10 present invention an unplasticised polyvinyl butyral sheeting is employed which is obtained by casting a film from a solution, with subsequent drying of the film produced, and with a casting solution having the following composition:—

- 150 gms. polyvinyl butyral powder (sold under the Registered Trade Marks "Butvar 5508", Shawinigan).
- 200 ccs. ethyl lactate.
- 20 700 ccs. trichlor ethylene.
- 300 ccs. industrial methylated spirits 64% to 68% o.p.

Alternatively, a slightly plasticised film having a non-sticky surface may also be cast according to the above formula but with the addition of $7\frac{1}{2}$ gms. of dihexyl phthalate as a plasticising agent. The casting solution may be rendered more easily flowing by increasing the proportions of trichlor ethylene and of industrial methylated spirits. The film of unplasticised or slightly plasticised polyvinyl butyral sheeting thus obtained from the casting solution may be used as interleaving material in forming the laminated glass using any of the above mentioned organic liquids or their combinations with each other. The polyvinyl butyral sheeting may also be conveniently formed upon 40 the glass by spraying it from a solution with subsequent removal of the volatile solvents applied in the spraying solution preferably by heat drying prior to laminating. By selecting the wetting liquid 45 according to the degree of toughness or plasticity required, for example by using dihexyl phthalate or amyl benzoate, various degrees of toughness or plasticity may be obtained in the resulting laminated glass as required for particular 50 conditions.

Having prepared one polyvinyl butyral sheeting as above described, the process of preparing the laminated product is carried 55 out as follows:—

The said sheeting is interleaved between sheets of glass or other materials after wetting the plastic material with the appropriate organic wetting liquid and the 60 assembled laminations are subjected to pressure in a rolling press, for example of the mangle type with the object of squeezing out the surplus wetting liquid. This

pressure operation may be accompanied by the application of heat. The laminated 65 product is then subjected to electric heat, gas heat, oil jacketed heat or steam jacketed heat and to elevated or/and diminished air pressure in a closed vessel or autoclave to receive the final curing 70 treatment to produce a homogeneous laminated body or sheet with unsealed edges. This procedure has the advantage of yielding a laminated glass in which the interleaving material retains substantially 75 even thickness whereas by using platen or "fluid rubber type presses" instead of an autoclave for the final curing operation the interleaving material is liable to be squashed out at the edges of the glass or 80 the like thus increasing the tendency for the appearance of "optical unevenness" in laminated glass. This result is not produced by the rolling press or mangle used in the initial treatment as this does not cause squeezing out of plastic material but is applied only in sufficient strength to remove surplus wetting liquid. Where a coloured product is required the polyvinyl butyral sheeting can be dyed by passing 90 it through a dye bath with subsequent drying the dyed sheet. The dye bath may be prepared according to the following formula:—

- 20 ccs. ethyl lactate
- 20 ccs. industrial methylated spirit 6.4% to 68% o.p.
- 60 ccs. ethylene dichloride
- 5 grams. Fast Orange A 150 (I.C.I.) sold under the Registered Trade Mark 100 "Dispersol"

Alternatively, organic dyestuffs may be dissolved in the organic wetting liquid used in the laminating process to obtain the various desired tones or tints of colour 105 in the ensuing finished laminated glass. Coloured and transparent laminated glass made with polyvinyl butyral sheeting as interleaving material and prepared as above described can be utilised in the 110 manufacture of optical photographic filters.

According to another method coloured gelatine filter sheeting may be included in the laminated product by interposing it 115 between two pieces of polyvinyl butyral sheeting to form the compound glass product, in order to make laminated glass colour filters containing the colouring matter in the gelatine layer. In the 120 manufacture of such coloured filters the glass may also be conveniently coated with a thin gold film prior to laminating to obtain special optical effects of colour and light absorption. Also optical lenses, 125 bent glass goggles and bent windscreen

sheeting may be made using polyvinyl butyral sheeting as an interleaving material. Also polymethyl methacrylate sheeting known under the registered trade mark "Perspex" may be laminated to glass by means of polyvinyl butyral sheeting as above described.

Plastic sheeting which polarises light and is known under the registered trade mark "Polaroid" may also be included in the lamination of polyvinyl butyral sheeting with glass by interposing the "Polaroid" plastic between two pieces of polyvinyl butyral prior to laminating between glass. In the case of laminating such "Polaroid" plastic embedded in polyvinyl butyral sheeting between glass care must be taken that the temperature of the pressure vessel in the final curing process does not exceed the temperature of 140° F. as otherwise the optical effect of polarisation caused by the crystals embedded in the polaroid material is liable to deterioration owing to the chemical decomposition of the optically orientated crystals at increased temperatures.

The procedure of laminating is carried out as follows in this particular case:— The polarised polyvinyl butyral sheeting is wetted with a mixture of 70 ccs of tri-butyl phosphate and 30 ccs. of dibutyl phthalate followed by treatment, as before, to remove the surplus wetting liquid and subsequent autoclave treatment preferably using a maximum temperature of 140° F. and a maximum pressure of 60 lbs. per sq. in. Also the glass sheets may be conveniently sprayed with coloured heat-cured thermo-hardening paint, for example, of the urea-formaldehyde or melamine-formaldehyde type prior to laminating with polyvinyl butyral sheeting for the manufacture of laminated glass panels which may be used as decorative panels in bathrooms and the like particularly as the same are highly resistant to moisture and cold temperatures. Such panels can also be utilised in the manufacture of road signs. So far the use of "Polyvinyl Acetal Type" plastic material in particular polyvinyl butyral has been described in its application to the manufacture of laminated compound glass only. Examples will now be given of the application of polyvinyl acetal type plastic sheeting in conjunction with materials other than glass in the form of plain boards or sheets and applicable for various purposes. Polyvinyl acetal known under the registered trade mark "Alvar" and polyvinyl formal known under the registered trade mark "Formvar" may be used as adhesive interleaving materials in the manufacture of laminated wood or ply-wood besides using polyvinyl butyral

also known under the registered trade mark "Butvar". Aluminium sheeting may be laminated to glass by interleaving polyvinyl butyral in the production of aluminium mirrors or aluminium paneling for heat insulation. The reflecting power of such laminated mirror-like products may be utilised for mirror-signs for use in adverse weather conditions such as at cross roads and in pavement lights. Also hollow glass bricks laminated on the inside with strips of aluminium sheeting or foil by the process according to the invention tend substantially to reduce the radiation losses obtained with the untreated glass bricks. Such aluminium laminated glass bricks may be used in the construction of outer walls thus reducing the radiation losses encountered with ordinary hollow glass bricks.

The bonding of aluminium to glass according to the invention can be used for other purposes wherever glass has to be incorporated in a metal structure, for example in producing certain light and colour effects to the lighting of rooms, the colour being incorporated in the polyvinyl butyral interleaving material as described above. Printed aluminium sheeting may likewise be laminated to glass. Also structural parts made from aluminium sheeting for aircraft components may be laminated to glass fibre cloth impregnated with polyvinyl butyral sheeting either unplasticised or plasticised according to requirements. Aluminium foil may also be laminated to glass for the manufacture of condensers for electrical purposes. When laminating aluminium sheeting to itself car number plates may be produced from a stock of aluminium base plates and of aluminium letters and numbers laminated to the base plate. The aluminium numbers and letters may be coated with coloured and heat cured thermo-hardening varnishes prior to laminating to make attractive car number plates in contrasting colours.

The invention may also be applied to the bonding of metal sheeting to wood-veneer for decorative purposes such as plywood-faced aluminium sheeting. In this way wooden structures may be strengthened with metal plates and laminated wooden furniture can be greatly strengthened, stiffened and made more serviceable by cementing veneered metal strips to the top and bottom surfaces of laminated bends. The flexural rigidity can be increased by such means without increase in weight, for instance, in the construction of tennis rackets or metal fittings and hinges may be cemented to strong wooden cover boards in office filing systems.

Aluminium or aluminium alloy sheet-

ing may be laminated to polyvinyl acetal type sheeting in the manufacture of laminated aluminium particularly for thick sections in order to reduce the amount of metal required and to increase the resistance to sound. Aluminium canopies with exposed structural aluminium shapes may be made by way of lamination as well as aluminium faced with tinted glass in various colours for structural and decorative purposes as mentioned before such as aluminium sheeting having multi-coloured designs and laminated to glass, in the manufacture of trays, table tops, and tea trolleys. Aluminium alloy and steel may be laminated to polyvinyl acetal in $\frac{1}{4}$ " thickness for structural purposes where light weight is an important factor. The joining of metal to metal such as aluminium to other metals can be conveniently carried out to eliminate joining by soldering and spot-welding which latter procedure may have a deteriorating effect upon metal sheeting of the aluminium group.

In the shoe and leather industry, leather and rubber may also be conveniently laminated together by means of polyvinyl acetal type sheeting as in the heel and soling of shoes.

Any of the thermo-plastic interleaving materials mentioned herein may contain admixtures of air drying or/and thermo-hardening and heat curing materials such as drying oil compounds, phenolformaldehyde, ureaformaldehyde and Melamine-formaldehyde compounds with or without the addition of plasticising materials for special purposes as it has been found that the combination of thermo-plastic and thermo-hardening material yields products of increased serviceableness compared with the single components. The admixture of the thermo-hardening material to the thermo-plastic material may be conveniently carried out in liquid form prior to the casting of films or the making of sheets.

The admixture of the above mentioned materials to polyvinyl acetals is particularly useful when laminating materials which obstruct the passage of light as the admixed products generally form opaque and non-transparent films which is of course unimportant when metal sheeting, wood and synthetic plastic material are laminated together such as when an underlying metal sheet is incorporated in laminated sheets intended for surfacing counters or table-tops in order to provide a heat conducting layer and to confer immunity from cigarette burns. Generally composite boards belong to this field where two or more different kinds of material may be laminated together in order to combine the

properties of various materials such as insulation boards having excellent heat insulation properties without being hard enough may be surfaced with synthetic resin materials and so forth. This applies likewise to the formation of composite boards for floors, walls, ceilings and shutters.

As mentioned before, the plastic interleaving materials mentioned are not necessarily applied in sheet or film form but may be built up to the required thickness by spraying them upon the sheets or boards to be laminated with subsequent drying off by heat of the low boiling solvents used in the spraying solution prior to laminating. The following examples for making such a spraying solution are given by way of illustration:—

- (1) 4 gms. polyvinyl formal (sold under the Registered Trade Mark "Formvar 1595", Shawinigan) 85
 2 ccs dimethyl glycol phthalate
 20 ccs ethyl lactate
 56 ccs trichlor ethylene 90
 24 ccs industrial methylated spirits 64% to 68% o.p.
- (2) 4 gms. polyvinyl butyral (sold under the Registered Trade Mark "Butvar 5598", Shawinigan) 95
 1 cc dihexyl phthalate
 20 ccs ethyl lactate
 56 ccs trichlor ethylene
 24 ccs industrial methylated spirits 64% to 68% o.p. 100

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. The process for the manufacture of compound glass and other laminated materials employing plastic sheeting of the polyvinyl acetate type for the interleaving material, characterised by the application thereto of a substantially water-immiscible organic wetting liquid consisting of an organic ester of phthalic, benzoic or phosphoric acid or a mixture thereof, in subjecting the assembled layers after treatment with the wetting liquid to mechanical pressure to eliminate surplus wetting liquid and in subjecting the compound material thus formed to final treatment under heat and under elevated or diminished pressure in a closed vessel. 105
2. The process according to Claim 1 wherein the plastic interleaving material consists of polyvinyl butyral sheeting either unplasticised or plasticised. 110
3. The process according to Claim 1 125

- or 2 wherein the said wetting liquid consists of dihexyl phthalate.
4. The process according to Claim 1 or 2 wherein the said wetting liquid consists of a mixture of dihexyl phthalate and amyl benzoate.
5. The process according to Claim 1 or 2 wherein the said wetting liquid consists of a mixture of tributyl phosphate and dibutyl phthalate.
6. The process according to Claim 1 or 2 wherein the interleaving material is formed by casting a film upon plate glass sheeting from a solution which includes ethyl lactate, trichlor ethylene and methylated spirit for the purpose of producing a sheeting having a non-sticky surface either unplasticised or slightly plasticised.
7. The process according to Claim 1 or 2 wherein the sheeting is formed by spraying the plastic material upon glass from a solution with subsequent removal of the volatile solvents used in the spraying solution by heat drying prior to laminating.
8. The process according to Claim 1 or 2 wherein the polyvinyl-acetal sheeting is dyed prior to its incorporation in the laminated assembly.
9. The process according to any of the preceding Claims wherein an organic dye-stuff is dissolved in the wetting liquid.
10. The process according to Claim 1 or 2 wherein a coloured gelatine filter sheet is included in the laminated product by interposing it between two pieces of the polyvinyl-acetal type sheeting.
11. The process according to Claim 1 or 2 wherein a plastic sheeting capable of polarising light is included in the laminated product by interposing it between two pieces of the polyvinyl-acetal type sheeting.
12. The process according to any of the preceding Claims wherein a thermo-setting material or materials is or are admixed with the plastic sheeting during the preparation thereof.
13. The processes for the manufacture of compound glass and other laminated materials with unsealed edges as herein described.
14. Compound glass and other laminated materials whenever prepared by the processes claimed in any of Claims 1 to 12.

Dated this 20th day of June, 1945.

HERON ROGERS & CO.,

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ERRATA

SPECIFICATION No. 590,235.

- Page 1, lines 40 and 45, for " unsealed "
 read " unsealed "
- Page 6, line 109, for " polyvinyl acetate "
 read " polyvinyl-acetal "

THE PATENT OFFICE.

10th November, 1947.